SUPER DSP FILTER

MODEL MFJ-784

INSTRUCTION MANUAL

CAUTION: Read all instructions before operating equipment

MFJ ENTERPRISES, INC.

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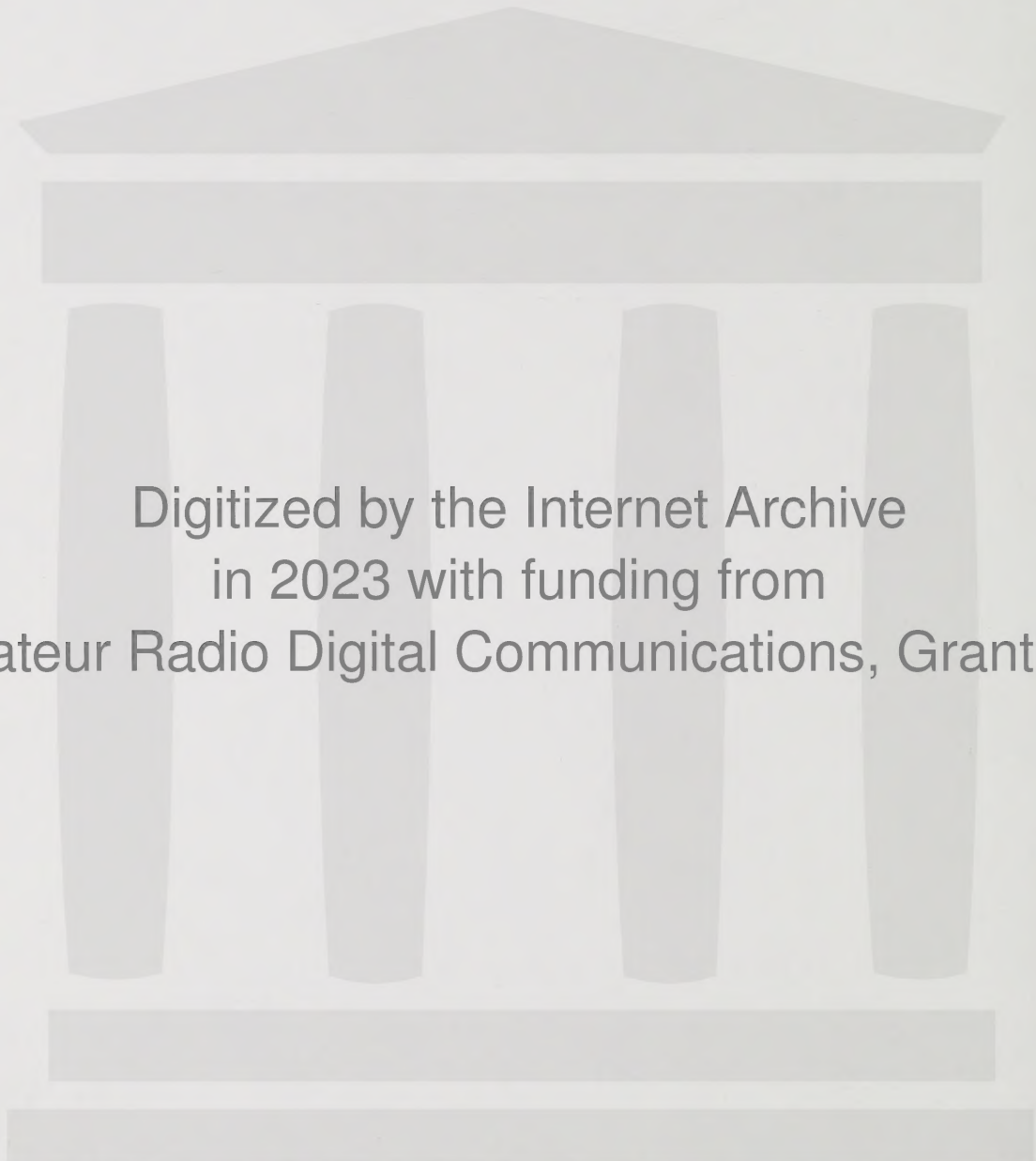

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MFJ-784 Super DSP Filter

The **Filter Specifications** chart lists the parameters for the ten filters available on the MFJ-784. Definitions for the abbreviations used on the chart are listed below:

LR: Low Reject Cutoff Frequency
HR: High Reject Cutoff Frequency
f1: Center or Notch Frequency #1
f2: Center or Notch Frequency #2
fc: Center Frequency
BW: Bandwidth
FIR: Finite Impulse Response
IIR: Infinite Impulse Response

Filter Specifications

Tunable Filter	Left Control	Right Control	Attenuation	Type
LRHR[1]	LR: 200-2200 Hz	HR: 1400-3400 Hz	60 dB @ 74 Hz outside passband	FIR linear phase
BP	fc: 300-3400 Hz	BW: 30-2100 Hz	50 dB @ 60 Hz outside passband	FIR linear phase
2BP[2]	f1: 300-3400 Hz	f2: 300-3400 Hz	50 dB @ 60 Hz outside passband	FIR linear phase
CW[3]	fc: 300-1000 Hz	BW: 30-700 Hz	50 dB @ 60 Hz outside passband	FIR linear phase
SSB[4]	fc: 600-1700	BW: 1000-2500 Hz	60 dB @ 74 Hz outside passband	FIR linear phase
Manual Notch	f1: 150-3400 Hz	f2: 150-3400 Hz	40 dB @ 95 Hz outside passband	IIR

All bandpass and highpass - lowpass filters have 24 mS delay times.

*1) The **LR - HR** filter becomes a band-reject filter when LR is adjusted higher than the HR.*
*2) The **2BP** filter uses the same bandwidth setting last used in **BP** filter but allows for independent variation of two center frequencies.*
*3) The **CW** filter has an optional jumper-programmable sidetone filter: see page 22*
*4) The **SSB** filter has its lowest cutoff frequency limited to 175 Hz.*

Pre-Set Filter	Mark-Space Freq.	Bandwidth	Attenuation	Type
RTTY	Jumper Programmable	250 Hz	50 dB @ 60 Hz outside passband	FIR linear phase
HF PACKET	Jumper Programmable	540 Hz	50 dB @ 60 Hz outside passband	FIR linear phase
AMTOR	Jumper Programmable	340 Hz	50 dB @ 60 Hz outside passband	FIR linear phase
PACTOR	Jumper Programmable	440 Hz	50 dB @ 60 Hz outside passband	FIR linear phase
SSTV	Dual filter with passbands fixed @ 1050-1350 Hz and 1450-2350 Hz		44 dB @ 60 Hz outside passband	FIR linear phase

* *All pre-set filters have 24 mS delay time.*
* *The data filters allow 170 or 200 Hz shift mark-space frequency; see page 22.*

Interference Filter	Frequency Range	Attenuation	Type	Delay
Multiple Automatic Notch	Entire freq. range of the received audio	Up to 50 dB, varies with stability of the heterodyne	Adaptive	8 mS max
Random Noise Reduction	Entire freq. range of selected bandpass filter	Up to 20 dB, varies with type of noise	Adaptive & adjustable	8 mS max

Notch Filters:

Multiple automatic notch attenuates up to 4 tones.
Manual notch attenuates 2 separate tones with the front panel knobs.
Automatic Notch is disabled in the following data modes:
CW, RTTY, HF PACKET, AMTOR, PACTOR, SSTV/ FAX/ WeFAX

Random Noise Reduction Filter:

Adaptive and manually adjustable algorithms provide up to 20 dB noise reduction.

Signal Processor:

Signal Processor:	Analog Devices ADSP-2105
Clock:	12 MHz
Data bit width:	16 bits

General Features:

Direct audio bypass when **ON - OFF** power switch is in **OFF** position.
Bandwidth of 2BP mode is saved when powering down.
Audio output power is 1.2 w into 6 ohms (MFJ power supply).
Audio frequency response is 250 to 3500 Hz (-3 dB).
Maximum audio input at full sensitivity is 3 volts P-P nominal (190 mW 6 ohms).
Input circuit loading is 10 K ohms nominal.

Rear Panel:

POWER:	10-16 Vdc @ .35 amp peak (low "Z " audio load)
HEADPHONES OUT:	1/4" stereo phone jack
SPEAKER OUT:	3.5 mm stereo phone jack
RECEIVE AUDIO IN:	RCA phono jack
INPUT LEVEL ADJUST:	screwdriver adjustable potentiometer
FILTERED AUDIO OUT:	RCA phono jack (~1.5 V P-P @ 600 ohms)
TO RADIO	5 pin DIN female (filtered audio out, PTT, receive audio).
TO TNC	5-pin DIN female (filtered audio out, PTT, receive audio).

Introduction to DSP

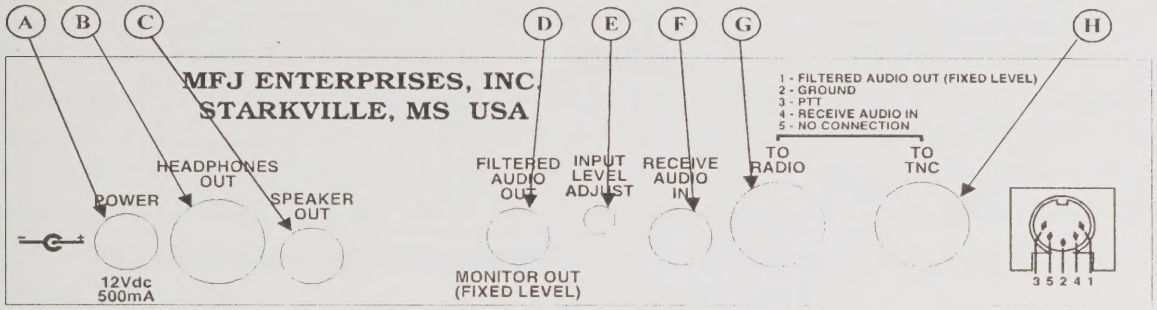
Recent advances in integrated circuits have greatly increased the processing power and reduced the size of DSP units. These same advances also lowered the cost of DSP filtering, making DSP technology affordable for the average amateur or short wave listener. DSP technology has existed for many years but has always been very complicated and expensive. The MFJ-784 Super DSP Filter uses state-of-the-art Digital Signal Processing (DSP) technology. DSP technology greatly improves signal clarity by reducing or eliminating noise (QRN) and interference (QRM).

A DSP unit converts the analog input signals to digital information. This conversion is achieved through the sampling of the signal many thousands of times per second with an A-to-D converter. The result is a string of digital "numbers" that represent the amplitude and frequency of the analog input signal. The resulting digital information can be processed with several different digital filter algorithms. The user can select different filter algorithms with the front panel controls. The end result is a digitized signal with undesired signal components either reduced or removed. The processed digital signal information is converted back to an audio signal by a digital-to-analog converter. The reconstructed analog signal is amplified and appears at the headphone and speaker jacks.

The heart of the DSP system is the ADSP-2105 "DSP" chip. The ADSP-2105 is similar to the CPU in a conventional home computer, but its commands are tailored to the type of instructions used in signal processing. The use of special DSP commands allows many DSP filter functions to be completed in very few clock cycles (a typical home computer CPU would require a long set of instructions and many clock cycles to perform the same functions). Almost any microprocessor can perform DSP, but only very fast or special-function processors perform DSP in *real time*. The analog device's ADSP-2105 16-bit processor used in the MFJ-784 is one of the most powerful processors available for amateur DSP applications.

Installation

In most cases, the MFJ-784 will be installed between the speaker or headphone audio-output of the receiver and your headphones or speaker. The illustration below shows the DSP's rear panel connectors and the function of each.



A: The **POWER** connector connects the MFJ-784 to a 10 - 16 Vdc, 350 mA (or larger) power supply.

B: The **HEADPHONES OUT** jack connects the MFJ-784 to your station headphones or speaker. Inserting a plug in this jack disables the SPEAKER OUT jack.

C: The **SPEAKER OUT** jack connects the MFJ-784 to your station speaker. A connection made to this jack disables the HEADPHONES OUT jack.

D: The **FILTERED AUDIO OUT** jack connects the MFJ-784 to the EXTERNAL AUDIO INPUT jack on a radio or other accessory. This jack has a fixed output independent from the DSP's volume control.

E: The **INPUT LEVEL ADJUST** controls the sensitivity of the RECEIVE AUDIO IN connector and pin 4 of the 5-pin DIN connectors.

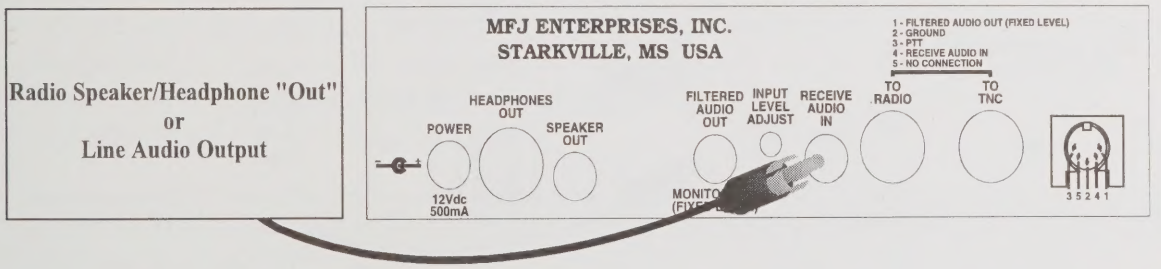
F: The **RECEIVE AUDIO IN** jack connects the MFJ-784 to the AUDIO OUTPUT of the radio.

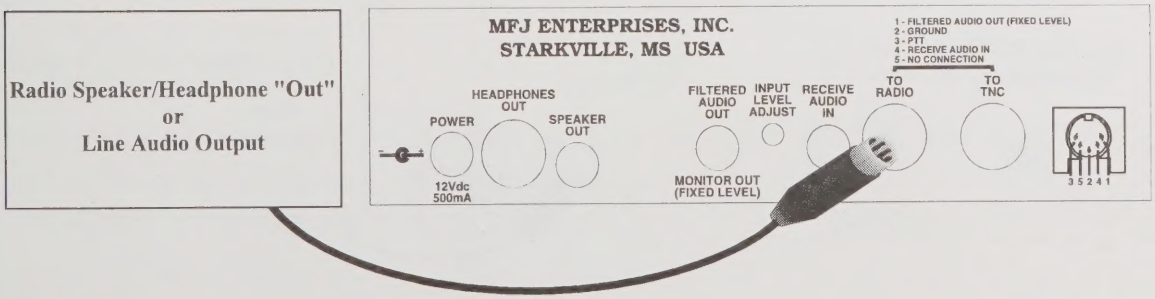
G: The **TO RADIO** jack supplies connections to the FLITERED AUDIO OUTPUT and the RECEIVE AUDIO IN. In addition, a connection is available for a PTT line to automatically bypass the filter during transmit.

H: The **TO TNC** jack supplies connections to the FLITERED AUDIO OUTPUT and the RECEIVE AUDIO IN. In addition, a connection is available for a PTT line to automatically bypass the filter during transmit.

These diagrams show the typical connections used to attach a radio to the MFJ-784. Only one of the following INPUT CONNECTIONS (either I or II) may be used.

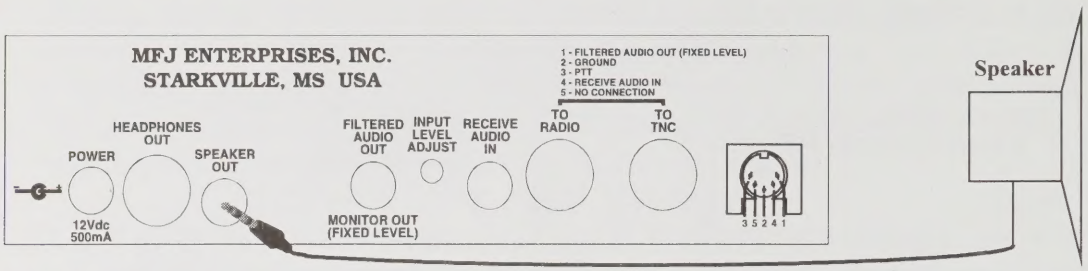
Input Connections



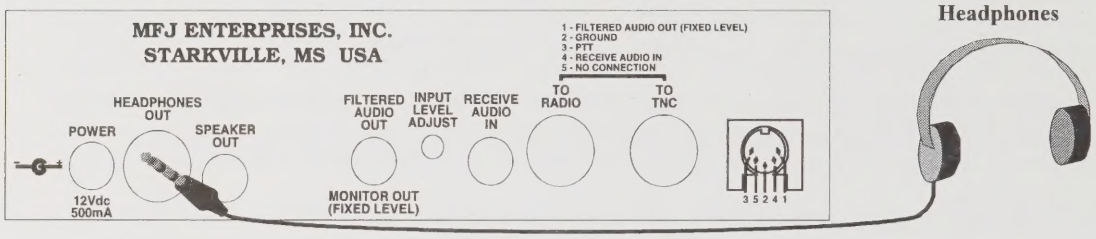


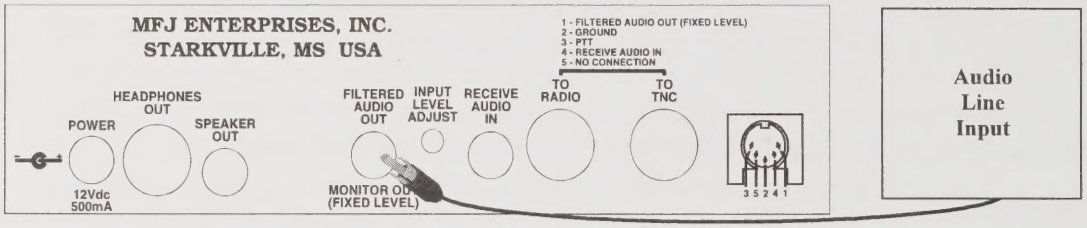
Output Connections

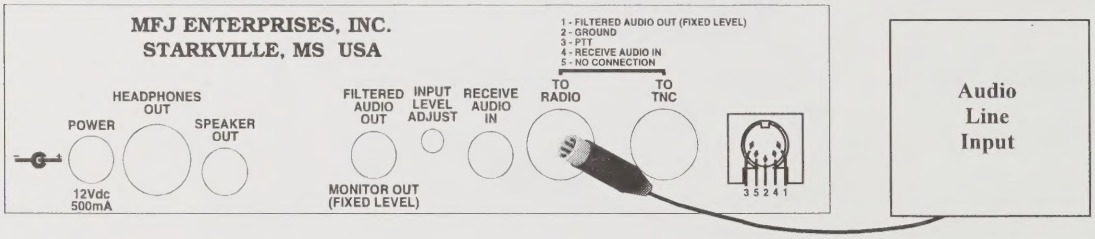
The diagrams below show examples of the typical output connections used to attach the MFJ-784 to your speaker(s), headphones, radio accessory, or data controller.

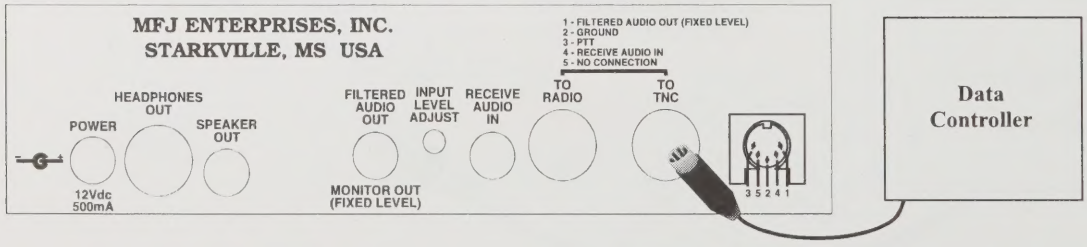


NOTE: The speaker may be attached to the HEADPHONES OUT jack instead of the SPEAKER OUT jack.









RECEIVE AUDIO IN

The input impedance of the MFJ-784 **RECEIVE AUDIO IN** jack is approximately 10,000 ohms. A minimum of 2 volts P-P (peak-to-peak) is required for full audio output when the **INPUT LEVEL ADJUST** (R5) is set for maximum sensitivity (rear view, full clockwise).

Audio input peaks that exceed 4 volts P-P will cause distortion, especially with the AGC or noise-reduction enabled. This distortion may occur while the audio output control of the receiver is at a normal gain setting. This distortion may be minimized or eliminated by adjusting the **INPUT LEVEL ADJUST** (R5) counterclockwise (rear view). Adjusting R5 counterclockwise allows higher audio input voltages to be applied to the DSP without causing distortion.

Most receivers will be stable driving the high (10,000 ohm) impedance of the MFJ-784. A lower impedance load should be added if your receiver fails to operate properly into the DSP's high input impedance. Connecting a two-watt resistor from the audio-input to ground on any of the unused rear panel RECEIVE AUDIO IN connections will supply the proper termination for the receiver. The resistor should be the proper value for the audio output impedance of the station receiver.

POWER

The **POWER** connector is labeled on the left rear panel of the MFJ-784. This connector accepts the dc input that powers the MFJ-784. The **POWER** connector of the MFJ-784 accepts a 2.1 mm coaxial plug with a positive polarity center conductor. An optional dc supply, the MFJ-1315, is available from MFJ.

The MFJ-784 requires a filtered voltage of 10 to 16 Vdc with a negative ground (or ground independent) power source. The maximum current demand changes with the volume level and the impedance of the load. The maximum current demand with a low impedance (1 ohm) audio load will be less than 350 mA at maximum volume. The current demand will decrease with higher impedance loads and with lower volume levels, but will always be more than 175 mA.

WARNING: Application of reverse polarity or voltages over 18 volts may permanently damage the MFJ-784.

HEADPHONES OUT

The **HEADPHONES OUT** jack can be used to connect the MFJ-784 audio output to headphones or a speaker. This jack accepts a standard male 1/4 inch stereo or mono headphone plug. The tip supplies the monaural audio and the ring supplies the ground.

This allows either stereo or monaural headphones, or a speaker. The **SPEAKER OUT** is disabled when a plug is inserted in the **HEADPHONES OUT** jack.

SPEAKER OUT

The **SPEAKER OUT** jack accepts a 3.5 mm monaural (mono) plug. This jack provides the same audio output as the **HEADPHONES OUT** jack. The "hot" audio signal appears on the tip. This jack will function with either mono or stereo plugs, but only the tip will supply audio. This jack is automatically disabled whenever a plug is inserted into the **HEADPHONES OUT** jack.

FILTERED AUDIO OUT

The **FILTERED AUDIO OUT** connector is a standard RCA phono jack. A quality shielded cable should be used when connecting the **FILTERED AUDIO OUT** to the TNC receive audio line. This jack provides approximately 1.5 volts P-P into 600 ohm (or higher) impedance loads. The output voltage of this jack is not affected by DSP volume control knob adjustments. The voltage level at the **FILTERED AUDIO OUT** jack will change with the audio input level when the DSP's AGC is turned off or if the DSP is bypassed. The voltage will remain nearly constant at 1.5 volts P-P when the AGC is operating.

INPUT LEVEL ADJUST

The **INPUT LEVEL ADJUST** controls the sensitivity of the MFJ-784 receive audio and the audio input pins (pin 4) of the DIN connectors. This control should be adjusted to reduce the input sensitivity if the voltage level from the receiver is too high. Proper adjustment is achieved if the receiver volume control can be set at the normal setting without overdriving the DSP (with the **AGC** and/or the **NOISE REDUCTION** operating).

RECEIVE AUDIO IN

The **RECEIVE AUDIO** connector is a standard RCA phono jack. A shielded cable should be used to connect the **RECEIVE AUDIO** connector to the station receiver. This jack should be driven with a minimum of 2 volts P-P, and no more than 3.5 volts P-P unless the setting of the **INPUT LEVEL ADJUST** (R5) is reduced (counterclockwise adjustment from rear view). This jack has an impedance of approximately 10,000 ohms, and is normally connected to the receiver's speaker or headphone output.

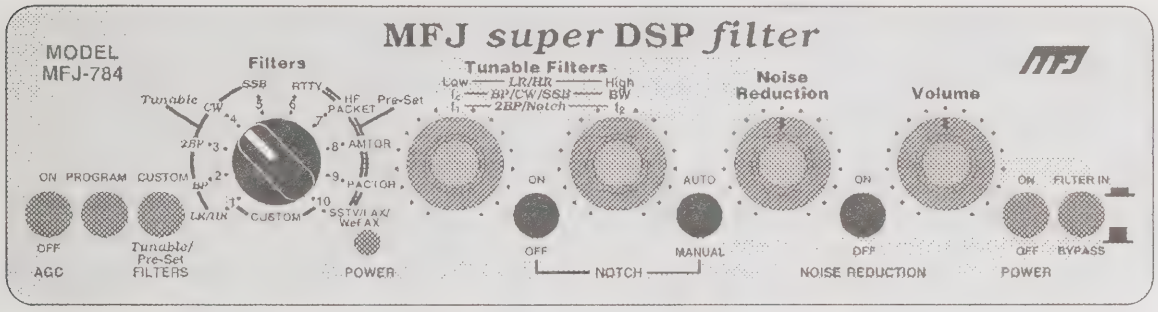
TO RADIO and TO TNC

The **TO RADIO and TO TNC** ports are standard ports used by all MFJ products. These ports allow the DSP unit to be connected to MFJ or other TNC without disturbing the speaker or headphone connections. These ports can be connected to virtually any radio with one of the pre-assembled MFJ-50xx series cables (available from MFJ). Each cable in this series is wired for a specific brand of radio.

The **TO RADIO and TO TNC** port also provide connections to the PTT line input. All signal processing functions are bypassed when this line is pulled low. Pulling the PTT line low allows the transceiver's sidetone and audio monitoring functions to appear at the DSP output without modification. The PTT line has a blocking diode to prevent other equipment connected to the PTT line (such as a linear amplifier) from damaging the DSP.

WARNING: never connect the PTT line to negative voltages or to positive voltage sources that exceed 35 volts. If a linear amplifier is connected to the PTT line, a blocking diode (1N4001 or equivalent) should be connected from the linear amplifier's control (relay) jack to the PTT line. The anode of the diode should be connected to the amplifier and the cathode (banded) to the PTT line.

FRONT PANEL



Eight push buttons, 5 knobs and one LED are present on the front panel of the MFJ-784 DSP unit. The following section will help you become familiar with the various functions of these items. These controls are explained as they appear from left to right on the panel.

AGC ON-OFF

This push button switch turns the AUTOMATIC GAIN CONTROL (**AGC**) ON or OFF. The **AGC** will maintain the same audio output level from the DSP if the input signal level changes are less than 17.8 dB (typical example: between 0.5 and 3.87 volts P-P).

Note: If the audio-input level from the receiver is too high the audio will distort on voice peaks. This is especially true when the AGC is being used.

PROGRAM

This non-latching push-button is used in conjunction with the **CUSTOM Tunable/ Pre-set FILTERS** button. Pushing this momentary contact switch saves the last filter setting used into the current Filters switch position (1-10).

*Example: A filter is adjusted to commonly used settings and the **CUSTOM Tunable/ Pre-set FILTERS** button is depressed. The DSP temporarily remembers all the front panel filter settings (except Volume, **AGC**, and BYPASS) at the moment the switch is locked. Locking this switch also disengages the filter adjustment knobs on the front of the unit.*

*The **Filters** knob is then placed at the position where the filter settings will be stored. When the **PROGRAM** button is momentarily pressed and held, the DSP will "beep" and the filter settings will be stored at that **Filters** knob position.*

*This non-adjustable, pre-programmed filter is always available whenever the **CUSTOM Tunable/Pre-Set FILTERS** button is in the "locked" position and the **Filters** knob is placed in the position where the filter information was stored.*

Custom Tunable/Pre-Set Filters

This rotary switch selects from 5 tunable filters (LR-HR, BP, 2BP, CW, and SSB) and 5 preset filters (RTTY, HF PACKET, AMTOR, PACTOR, SSTV/ FAX/ WeFAX) in the "out" position, or up to 10 custom user-programmed filters (1-10) in the "locked" position.

Note: This button also stores the currently used filter setting into a "temporary memory" the moment this button is pressed and locked. This temporary memory can be used to move the filter to a custom location. *See the **PROGRAM** button section for additional details of this function.*

Filters

This switch selects any one of the 5 tunable filters (LR-HR, BP, 2BP, CW, and SSB) or 5 preset filters (RTTY, HF PACKET, AMTOR, PACTOR, SSTV/ FAX/ WeFAX) with the **CUSTOM Tunable/Pre-Set FILTERS** switch in the "out" position, or one of the 10 available user-programmed (custom) filters (1-10) with the **CUSTOM Tunable/Pre-Set FILTERS** switch in the "locked" position. *See the **FILTER DESCRIPTION** section on page 13 for detailed information.*

Tunable Filters

The **Tunable Filters** controls adjust the frequency and the bandwidth of the various filters. The chart below summarizes the adjustments made by each control to the filters.

Mode	Left Control	Right Control
LR/HR	lowest freq.	highest freq.
BP	center freq.	bandwidth
2BP	center freq. 1	center freq. 2
CW	center freq.	bandwidth
SSB	center freq.	bandwidth
NOTCH *(manual only)*	notch freq. 1	notch freq. 2

Note: The ***manual notch*** *function uses the same frequency controls as the filters. The adjustable filters cannot be changed while the manual notch is being used. The MFJ-784 always remembers the tunable filter's settings at the moment the manual notch is activated.*

NOTCH ON - OFF

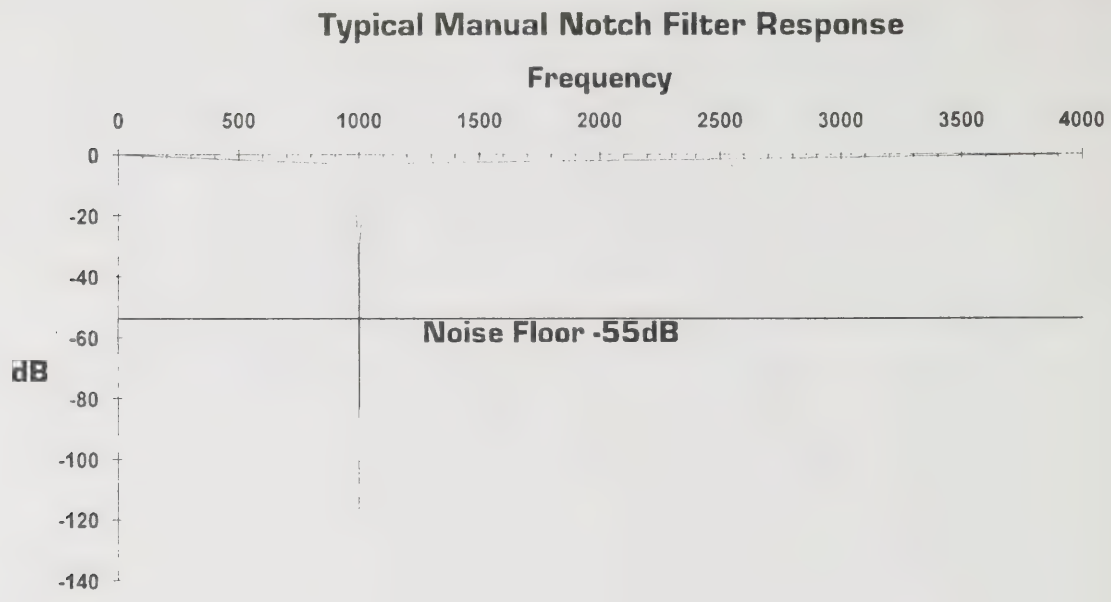
This locking push-button switch enables (in) or disables (out) the notch function. Up to four frequencies may be notched in the **AUTO** mode. Two frequencies can be manually notched in the **MANUAL** mode. The attenuation of the notch filter can be as great as 50 dB in the automatic mode, and 40 dB in the manual notch mode. The automatic notch filter is disabled in the following **Filters** switch data positions: CW, RTTY, HF PACKET, AMTOR, PACTOR, and SSTV-FAX-WeFAX.

NOTCH AUTO - MANUAL

The AUTO - MANUAL locking push-button selects either the two manual notch adjustments (out position) or the automatic notch filters (in and locked position). The **Tunable Filters** controls are used to adjust the notch frequencies when the AUTO - MANUAL switch is in the OUT (manual) position. The **Tunable Filters** knobs will vary each notch frequency from 150 to 3400 Hz. The manual notch bandwidth is 275 Hz at -3 dB, and 85 Hz at -40 dB. Since the manual notch uses the **Tunable Filters** controls to adjust the notch frequency, the filter selected by the **Filters** switch must be properly adjusted before engaging the manual notch. The MFJ-784 will "remember" the **Tunable Filters** setting at the moment the manual notch is engaged, and the **Tunable Filters** controls will adjust the manual notch frequencies.

In the AUTO (in) position, a multiple automatic notch searches for heterodynes or steady tones and nulls them. The automatic notch will not function in any of the following **Filters** switch data mode positions: CW, RTTY, HF PACKET, AMTOR-PACTOR, and SSTV-FAX-WeFAX. NOTE: *The automatic notch will not recognize interference that varies rapidly in frequency or amplitude. This is because the filter must ignore rapid amplitude and frequency changes to avoid nulling or distorting voices.*

The following graph shows the digital response of the manual notch filter.



Noise Reduction

This knob varies the noise reduction level. Maximum noise reduction is available in the full clockwise position, where random noise can be attenuated more than 20 dB (depending on the type of noise). This algorithm uses both adaptive and adjustable LMS (Least Mean Square) algorithms.

NOISE REDUCTION ON - OFF

This push button turns the noise reduction ON (in) or OFF (out). The noise reduction functions in all filter modes except bypass.

*Note: If the audio input level from the receiver is too high the audio will distort on audio peaks. This is especially true when the **NOISE REDUCTION** is being used.*

Volume

The **Volume** knob controls the gain of the internal 1-watt audio amplifier, and adjusts the audio output available at the **HEADPHONES OUT** and the **SPEAKER OUT** jacks. The **Volume** knob does not adjust the audio output level at the **FILTERED AUDIO OUT, TO RADIO, and TO TNC PORTS**.

POWER ON - OFF

This push-button switch controls the main dc power to the internal DSP electronics. The DSP audio is directly bypassed when the **POWER** is in the OFF position. The audio

input lines from the TO **RADIO, TO TNC PORT** and the **RECEIVE AUDIO** connectors are internally connected directly to the **HEADPHONES OUT** and **SPEAKER OUT** connectors. The audio output lines at the **FILTERED AUDIO OUT** jack and the TO **RADIO and TO TNC PORTS** are "dead" when the **POWER** switch is OFF (out).

FILTER IN - BYPASS

The FILTER IN - BYPASS switch either processes the audio (FILTER IN) or routes the audio through the DSP electronics without any digital processing (BYPASS). Audio output is available at the **HEADPHONES OUT, SPEAKER OUT, and FILTERED AUDIO OUT** jack and the **TO RADIO and TO TNC PORT** when this switch is in the BYPASS position, but the output voltage will no longer be a constant 1.5 V P-P since the internal digital AGC can not operate in the BYPASS mode.

Filter Description

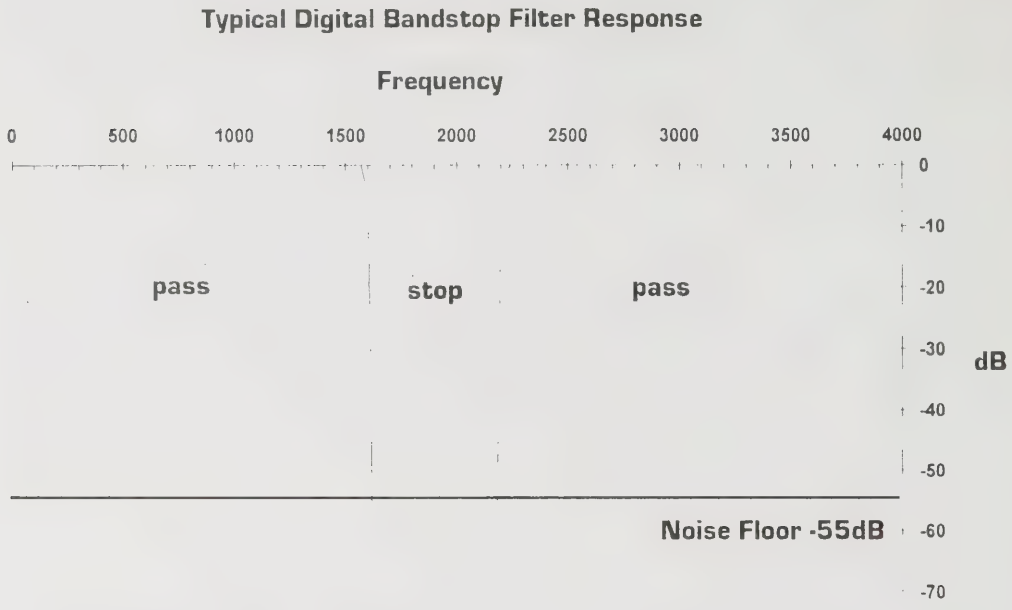
The following section describes in detail the filters available through the **Filters** switch.

Position 1, LR/HR

This position selects an adjustable low reject/high reject filter. The low reject filter (left knob) removes all signals below a user-selected frequency. The low reject filter cut-off frequency can be varied between 200 Hz and 2200 Hz with the left-hand **Tunable Filters** knob.

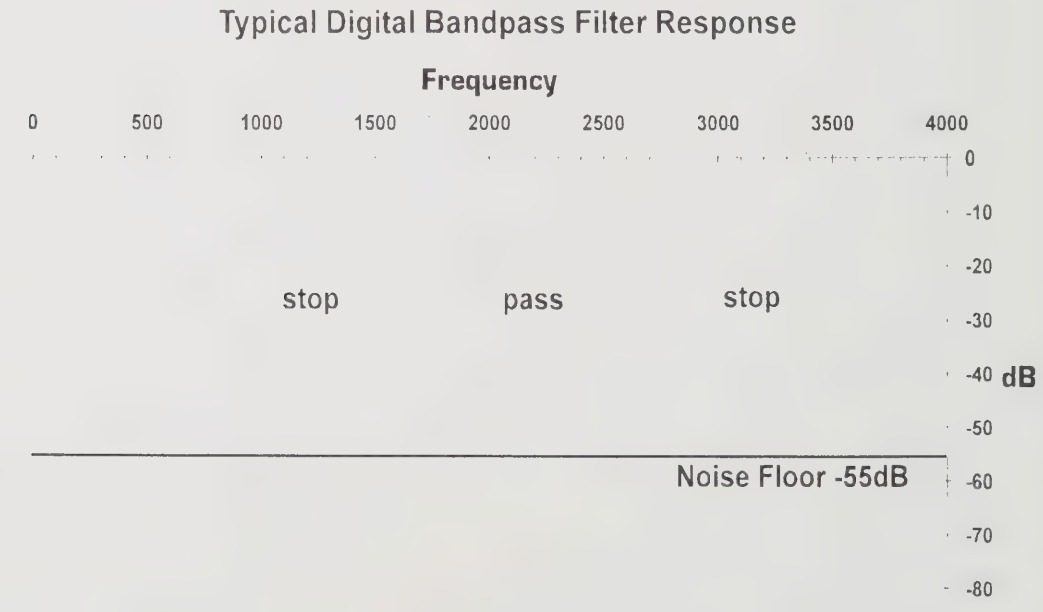
The high reject filter removes all signals above the selected frequency. The high reject limit is adjustable from 1400 to 3400 Hz with the right hand **Tunable Filters** knob. For example, if the low reject filter is adjusted to 300 Hz, and the high reject filter is adjusted to 3000 Hz, all frequencies below 300 Hz and above 3000 Hz will be rejected. The DSP filter will only pass frequencies from 300 Hz to 3000 Hz. A special filter can be created by adjusting the LR **Tunable Filters** knob to a frequency that is *higher* than the high reject **Tunable Filters** knob Frequency. This filter is called the **bandstop filter.** This bandstop filter removes all signal frequencies in the center of the two settings, and passes all signal frequencies outside the settings of the two knobs. In other words, it makes a "hole" in the middle of the frequency range.

If the low reject **Tunable Filters** knob is adjusted to a frequency higher than the high reject **Tunable Filters** knob, the filter will remove all frequencies in the center of the two settings, and pass all frequencies outside the settings of the two filters. This creates a band-stop filter that makes a "hole" in the middle of the signal frequency range. Thus, if the low reject filter is adjusted to 1900 Hz and the high reject filter is adjusted to 1500 Hz, all frequencies between 1500 Hz and 1900 Hz will be removed.



Position 2, BP

This filter is an adjustable band-pass filter. The bandwidth is controlled by the right **Tunable Filters** knob. This adjustment is similar to the selectivity control on a receiver. It can be adjusted from 30 to 2100 Hz in 16 Hz steps. The left **Tunable Filters** knob varies the center frequency between 300 and 3400 Hz. This adjustment is very much like the pass-band tuning or IF shift control on high quality receivers.



Position 3, 2BP

This position allows the use of two frequency-independent band-pass filters in parallel. The left and right **Tunable Filters** knobs control the individual center frequencies of the filters.

Each filter has exactly the same bandwidth. This position uses the selectivity setting of the BP filter. The bandwidth can be adjusted by switching to the BP position and adjusting the right-hand Tunable Filters Knob (see above section)

*Example: The **Filters** knob may be placed in the BP position and the right **Tunable Filters** knob adjusted to 100 Hz of bandwidth. The **2BP** filter will now have two filters available, with the left **Tunable Filters** knob controlling a 100 Hz filter and the right **Tunable Filters** knob controlling a second 100 Hz filter.*

Position 4, CW

*Note: The automatic notch function is disabled when the filter is in the **CW** mode.*

The CW position of the **Filters** switch provides an adjustable bandpass filter that can be varied over the normal frequency range preferred by most CW enthusiasts. The center frequency (or pitch) is controlled by the left **Tunable Filters** knob, and has a frequency range of 300 to 1000 Hz. This **Filters** knob functions similarly to the pass-band tuning or the IF shift control of a receiver.

The right **Tunable Filters** knob adjusts the filter bandwidth from 30 to 700 Hz. This knob acts exactly like the selectivity control on a receiver.

The operator may prefer to listen to a tone that is different than the sidetone of the transmitter. In this situation, the filter may not pass the sidetone and the operator may not be able to monitor his sending. Two procedures may be used to correct this problem.

The first (preferred) method for allowing the sidetone through is to ground the PTT line (pin 3 on either rear panel DIN connector) during transmission. This procedure will bypass the DSP and pass any sidetone frequency. The TO RADIO and TO TNC section describes the PTT function (page 8) explains the hardware requirements in more detail.

The second (less preferred) method for allowing sidetone through involves activating and programming an internal constant frequency filter. This method has the advantage of not requiring a PTT connection, but the disadvantage of allowing unwanted signals to feed through if they happen to be within 30 Hz of the sidetone frequency. This option makes the DSP behave like two separate parallel filters. One filter is the standard adjustable CW filter and the other is the fixed frequency (sidetone) filter. The sidetone filter is activated and adjusted with internal jumpers.

The section on page 21 describes jumper operation. The center frequency of the sidetone filter ranges from 300 to 1000 Hz in 50 Hz increments. The bandwidth of the sidetone filter is fixed at 50 Hz.

Position 5, SSB

The SSB filter is a bandpass filter with adjustable center frequency range of 600 Hz to 1700 Hz. The right tunable filters knob adjusts the bandwidth from 1000 Hz to 2500 Hz. The lowest audio limit is fixed at 175 Hz or higher. The upper frequency response can never extend above 2950 Hz. The actual audio response limits are adjustable, but the lowest frequency is always limited to 175 Hz or higher. Response can never extend below 175 Hz or above 2950 Hz.

While some voice transmissions may be understandable with only 1000 Hz of bandwidth if the center frequency is properly adjusted, the majority of stations will be copied best with the controls nearly centered. The optimum center frequency and bandwidth setting will the transmitting operator's voice, the transmitter's response, the receiver's response, any noise or QRM, and/or the receiving operator's hearing.

Position 6, RTTY

The RTTY filter's center frequency can be adjusted by moving internal jumpers. These jumper settings are detailed on page 21. The RTTY filter has a bandwidth of 250 Hz. This bandwidth offers excellent performance with standard 170 Hz shift, 45 baud RTTY signals. Under special conditions the operator may wish to use one of the Adjustable Bandpass Filters.

Position 7, HF PACKET

The HF PACKET filter center frequency can be adjusted by moving internal jumpers. The jumper settings are detailed on page 22. This filter has a bandwidth of 540 Hz, and is the optimum filter for a 200 Hz shift, 300 baud signal. Under special conditions the operator may wish to use one of the **Adjustable bandpass filters.**

Position 8, AMTOR

The AMTOR filter center frequency can be adjusted by moving internal jumpers. The jumper settings are detailed on page 22. This filter has a bandwidth of 340 Hz. This is the optimum filter for 200 Hz shift, 100 baud data. Under special conditions the operator may wish to use one of the **Adjustable bandpass filters.**

Position 9, PACTOR

The AMTOR/PACTOR filter center frequency can be adjusted by moving internal jumpers. The jumper settings are detailed on page 22. This filter has a bandwidth of 440 Hz. This is the optimum filter for 200 Hz shift, 200 baud data. Under

special conditions the operator may wish to use one of the **Adjustable bandpass filters.**

Position 10, SSTV/ FAX/ WeFAX

This filter is a dual bandpass filter that allows two separate frequency groups to pass through the filter. The first filter is pre-set to pass frequencies between 1050 and 1350 Hz. The second filter passes 1450 to 2350 Hz.

Operational Procedures

Initial Operation

Connect the MFJ-784 as outlined earlier in the section INSTALLATIONS on page 4. Set the controls as follows to prepare the unit for operation.

AGC:	OFF (out)
PROGRAM:	N/A
FILTERS:	Tunable/ Pre-Set (out)
Filters:	CW
Tunable Filters:	both knobs in center of range
NOTCH:	ON/OFF switch to off (out)
NOTCH:	AUTO/MANUAL to auto (in)
Noise Reduction:	minimum (full counter clockwise)
NOISE REDUCTION:	ON/OFF switch to OFF (out)
Volume:	minimum (full counter clockwise)
POWER:	OFF (out)
FILTER IN - BYPASS:	out (bypass)

The external power supply should be connected and on. The headphones or speaker should be connected to the output jack. Be aware that whenever a plug is inserted in the headphone jack, the speaker jack will be disconnected.

The MFJ-784 should be "powered up" by depressing the OFF/ON button. During this initial operational phase, the **POWER** indicator will glow *red*. The red glow indicates the normal filter modes are selected. The **POWER** indicator will glow *green* if the custom filters are selected. Press and release the **Filters** button if the **POWER** indicator is green.

This DSP unit provides the unique ability to customize filters for many different applications. For example, while most other filters only provide one pass frequency on CW, this filter is adjustable from 300 to 1000 Hz tones. Instead of limiting the bandwidth to two or three pre-determined settings, the MFJ-784 allows the user to adjust the bandwidth continuously between 30 and 700 Hz.

CW Operation

This operational example demonstrates how the CW filter operates and helps adjust the audio from the station's receiver to the proper drive level for the DSP.

The CW station should be tuned with comfortable levels of pitch and volume. Next, the **FILTER IN - BYPASS** button should be locked in, and the **Volume** control of the DSP adjusted to a comfortable setting.

NOTE: *Always use the DSP's volume control to adjust the volume when the DSP power is on unless told otherwise.*

1.) Adjust the center frequency (left Tunable Filters knob) to peak the CW signal.

2.) Leave the bandwidth at its mid position (right Tunable Filters knob) to the desired bandwidth or selectivity. Note that the desired CW becomes clearer (less noise and QRM) as the selectivity is increased.

3.) Engage the AGC by pressing and locking the **AGC** button. Adjust the receiver's volume control until the DSP's audio output is only slightly higher with the **AGC** engaged than it is with the **AGC** disengaged.

> *Note: If the audio input level from the receiver is too high, the audio will distort on audio peaks. This is especially true if the AGC and* ***Noise Reduction*** *are being used.*

4.) Switch the DSP's **FILTER IN - BYPASS** button ON(in) and OFF(out) to confirm that the signal is slightly louder with the DSP engaged than it is with the DSP bypassed. The signal should have slightly less volume with the DSP bypassed.

5.) If the *receiver's* volume control is now set abnormally low, advance it to a more normal setting. Adjust the rear panel **INPUT LEVEL ADJUST** with a small flat-bladed screwdriver until turning the **AGC** off only slightly reduces (and ON slightly increases) the DSP's audio output. This adjustment can be confirmed by repeatedly engaging and disengaging the DSP (with the DSP's AGC on). The audio level should barely decrease with the filter bypassed.

6.) Place the DSP filter in the BYPASS mode, and adjust the receiver until a frequency is found that has several CW signals audible at the same time. When the DSP filter is placed back on line (FILTER IN), the **Tunable Filters** knobs can be adjusted to select one signal at a time. Careful adjustments to the DSP filter's center frequency (with moderate or high selectivity), may allow the user to find perfectly readable signals that are undetectable without the filter.

7.) Experiment with the **NOISE REDUCTION** and the **Tunable Filters** controls in the CW mode until you become familiar with the function and effects of these controls.

SSB Operation

The example in this section demonstrates the basic SSB filter functions, and allows for further confirmation of the station receiver audio level adjustments. Place the DSP **Filters** switch in the SSB mode and turn the **AGC** and **NOISE REDUCTION** off. Place the **FILTER IN - BYPASS** switch in the BYPASS position (out).

Tune in a SSB station with normal pitch and volume. Press and lock the **FILTER IN - BYPASS** button. Adjust the Volume control of the DSP to a comfortable volume setting.

NOTE: *Always use the DSP's volume control to adjust the volume when the DSP power is on unless specifically told otherwise.*

1.) Adjust the center frequency (left **Tunable Filters** knob) and the bandwidth (right **Tunable Filters** knob) to peak the SSB signal for maximum intelligibility.

2.) You will find that the desired signal becomes clearer (less noise and QRM) as the selectivity is increased and the center frequency is readjusted.

3.) Engage the AGC by pressing and locking the **AGC** button. Adjust the *receiver's* volume control until the DSP's audio output is only slightly weaker when the **AGC** is disengaged.

4.) Turn the DSP's **FILTER IN/BYPASS** button ON (in) and OFF (out) to confirm that the signal is just slightly louder with the DSP engaged than it is with the DSP bypassed.

5.) If the *receiver's* volume control is set abnormally low, advance it to a normal setting. Adjust the rear panel **INPUT LEVEL ADJUST** with a small flat-bladed screwdriver until turning the **AGC** off barely reduces the DSP's audio output. This adjustment can be confirmed by disengaging the DSP (with the DSP's AGC on). The audio level should barely decrease with the filter bypassed.

NOTE: *Some compromise may be required if the receiver does not maintain the same audio level on different modes. Set the* ***AUDIO LEVEL ADJUST*** *on the DSP for the most common mode, and use the receiver's volume knob to properly adjust the level when switching modes.*

6.) Place the DSP filter in the BYPASS mode. Adjust the receiver until you find a frequency that has a CW or other heterodyne signal audible with the desired SSB signal.

7.) Place the filter back in line with the **FILTER IN** button. Press the **NOTCH ON** and the **NOTCH AUTO** buttons, and the interference should disappear or be greatly reduced.

NOTE: The automatic notch will not recognize signals that vary rapidly in frequency or amplitude, because the filter must ignore rapid amplitude and frequency changes to avoid milling or distorting voices.

8.) The user should experiment with different filter adjustments and functions under various conditions until he becomes familiar with the functions of the various controls.

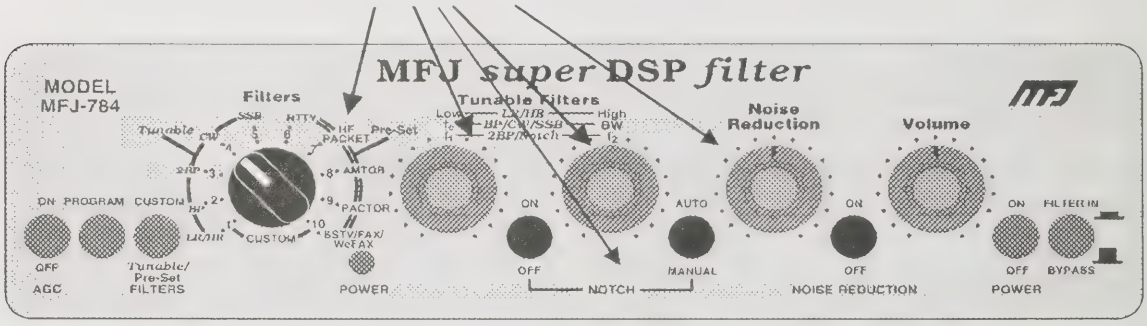
Note: If the audio input level from the receiver is too high the audio will distort on voice peaks. This is especially true when the AGC and Noise Reduction are being used.

Programming a Filter

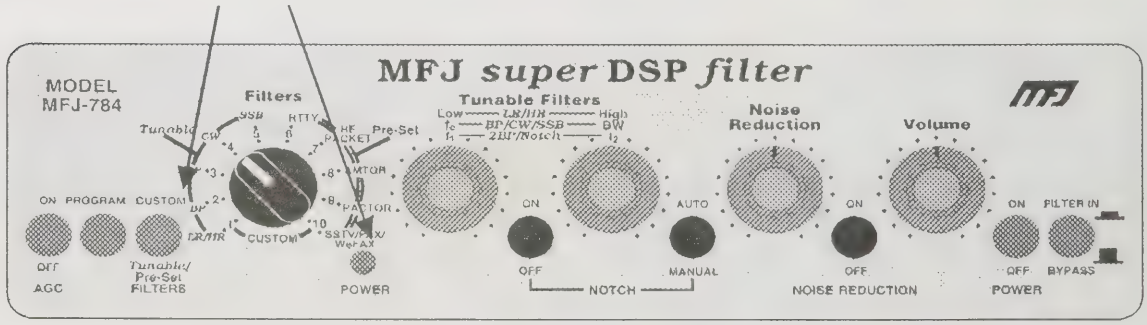
Up to 10 filters may be stored in memory with this DSP unit. A filter program is stored by first adjusting a filter to the desired settings. The memory will remember all of the front panel knob and push button settings except for the **AGC ON - OFF**, **POWER ON - OFF**, **Volume** and **FILTER IN - BYPASS** functions.

A filter is stored by performing the following steps:

1.) The user selects the filter mode and the control settings that he wants to store.

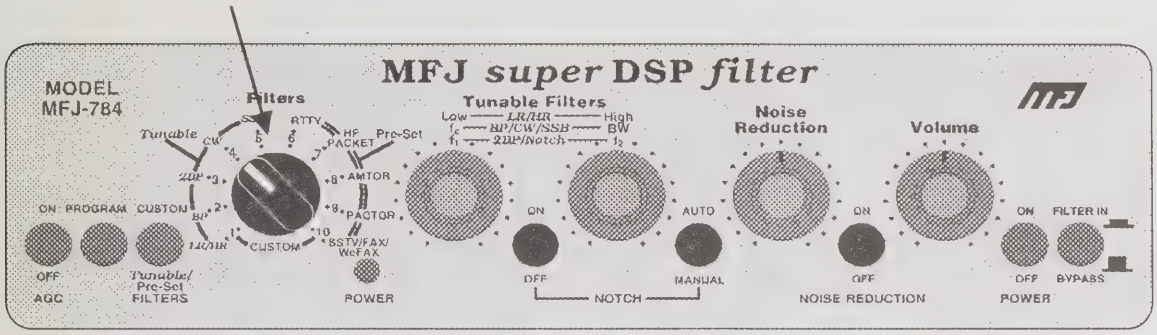


2.) Enter the "custom" mode by pressing and locking the **CUSTOM Tunable/Pre-Set FILTERS** button in the CUSTOM position. The **POWER** indicator should now turn green.

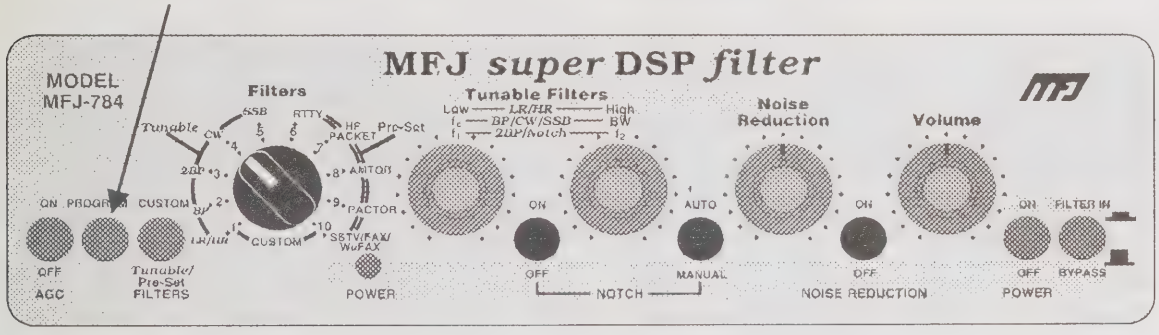


NOTE: ***The filter will temporarily change functions. This change does not affect the settings stored in the temporary memory.***

3.) Turn the **Filters** knob to the position where the new settings will be stored.



4.) Press and hold the **PROGRAM** button. The power indicator will light *red* and beep within one second. Release the **PROGRAM** button. The selected **Filters** position will now operate with these settings until the **PROGRAM** button is depressed again.

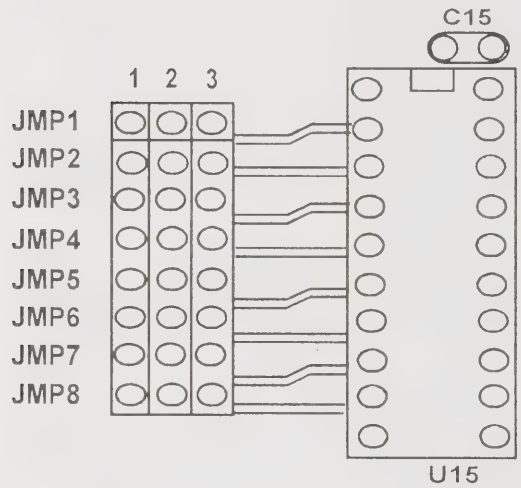


NOTE: The programmable filters stored in memory can not be adjusted. Only the ***AGC ON - OFF, POWER ON - OFF, Volume, and FILTER IN - BYPASS*** *functions will still have an effect when in the CUSTOM mode.*

Jumper Settings

The MFJ-784 has provided the user with the ability to enable and set the CW sidetone filter frequency and to change the data mode mark-space frequencies (RTTY, HF Packet, AMTOR, and PACTOR) by removing the cover and moving a group of plug in jumpers. These moveable black jumpers are located on the circuit board next to U15.

These jumpers groups will be referred to by number to simplify identification. A diagram of the jumper area is shown below. More information on jumpers settings may be found on the *JUMPER SETTINGS CHARTS* on page 22. Jumpers 1 through 4 control the CW SIDETONE frequencies. These jumpers must be set to match the sidetone filter of the MFJ-784 to the sidetone frequency of the transceiver to enable the sidetone filter. Jumpers 5 through 7 control the DATA MODES frequencies. Jumper eight is not used.



NOTE: The chart to the left shows the position of the jumper settings area on the circuit board. The JUMPER SETTINGS CHARTS contain more detailed information on the jumper settings and how each affects the unit's operation.

CW Default

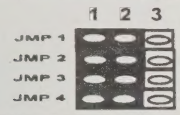
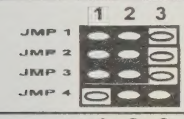
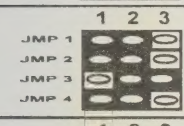
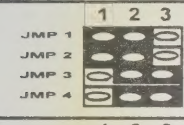
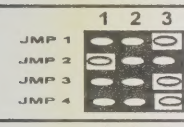
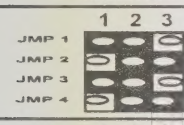
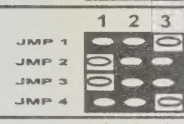
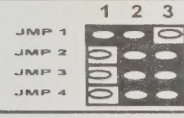
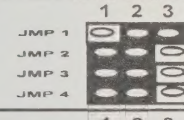
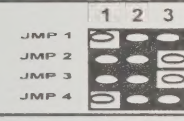
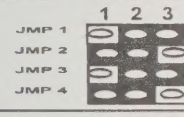
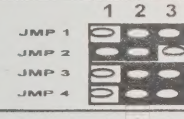
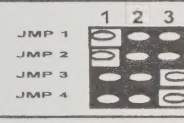
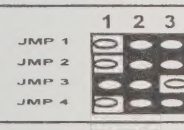
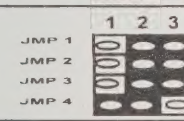
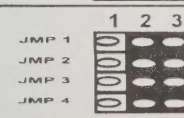
The DSP unit is shipped with the CW sidetone filter set in the "OFF" position. The CW sidetone filter bandwidth will always remain fixed at 50 Hz.

DATA Default

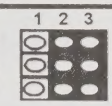
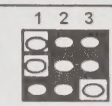
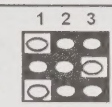
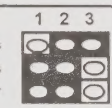
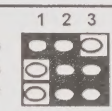
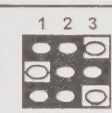
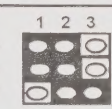
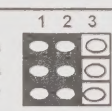
The data modes are set to a default mark-space frequency of 2125 - 2295 or 2110-2310 Hz, with shift of 170 or 200 Hz and various bandwidths selected by the filters knob.

JUMPER SETTINGS CHARTS

CW SIDETONE SETTINGS

JUMPER SETTINGS	CENTER FREQUENCY (Hz)
	300
	350
	400
	450
	500
	550
	600
	650
	700
	750
	800
	850
	900
	950
	1000
	* no sidetone

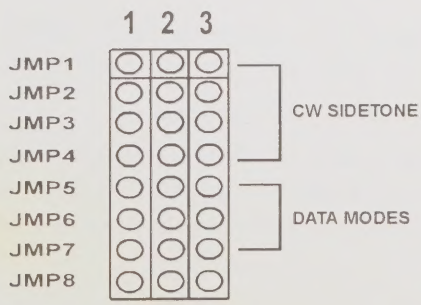
DATA MODES SETTINGS

JUMPER SETTING	SHIFT (Hz)	MARK:SPACE FREQUENCY (Hz)
	170, 200	* 2125 - 2295, 2110 - 2310
	170, 200	1215 - 1385, 1200 - 1400
	170, 200	1275 - 1445, 1260 - 1460
	200	1430 - 1630
	170, 200	1615 - 1785, 1600 - 1800
	200	2025 - 2225
	170, 200	2125 - 2295, 2110 - 2310
	200	2125 - 2325

* FACTORY DEFAULT SETTINGS

JUMPER

THE JUMPERS CONTROLLING CW AND DATA MODES ARE LOCATED ON THE CIRCUIT BOARD NEAR C15. DIAGRAM 1 SHOWS THE POSITIONS OF JUMPERS 1 THROUGH 8. THE CHARTS SHOW ALL THE JUMPER COMBINATIONS AND HOW EACH AFFECTS THE PERFORMANCE OF THE MFJ-784.



(Diagram 1)

Technical Assistance

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or your problem is not solved by reading the manual you may call MFJ toll-free at 1-800-647-TECH (8324) or FAX to 601-323-6551. Outside of the continental call USA. 601-323-5869. You will be best served if you have your unit, manual and all information on your station handy so you can answer any questions the technicians may ask.

You can also send questions to MFJ Enterprises, INC., PO. Box 494, Mississippi State, MS 39762. Send a complete description of your problem, an explanation of exactly how you are using your unit and a complete description of your station.

FULL 12 MONTH WARRANTY

MFJ Enterprises, Inc. warrants to the original owner of this product, if manufactured by MFJ Enterprises, Inc. and purchased from an authorized dealer or directly from MFJ Enterprises, Inc. to be free from defects in material and workmanship for a period of 12 months from date of purchase provided the following terms of this warranty are satisfied.

1. The purchaser must retain the dated proof-of-purchase (bill of sale, canceled check, credit card or money order receipt, etc.) describing the product to establish the validity of the warranty claim and submit the original of machine reproduction of such proof of purchase to MFJ Enterprises, Inc. at the time of warranty service. MFJ Enterprises, Inc. shall have the discretion to deny warranty without dated proof-of-purchase. Any evidence of alteration, erasure, of forgery shall be cause to void any and all warranty terms immediately.

2. MFJ Enterprises, Inc. agrees to repair or replace at MFJ's option without charge to the original owner any defective product provided the product is returned postage prepaid to MFJ Enterprises, Inc. with a personal check, cashiers check, or money order for **$7.00** covering postage and handling.

3. MFJ Enterprises, Inc. will supply replacement charges free of charge for any MFJ product under warranty upon request. A dated proof of purchase and a **$5.00** personal check, cashiers check, or money order must be provided to cover postage and handling.

4. This warranty is **NOT** void for owners who attempt to repair defective units. Technical consultation is available by calling (601) 323-5869

5. This warranty does not apply to kits sold by or manufactured by MFJ Enterprises, Inc.

6. Wired and tested PC board products are covered by this warranty provided **only the wired and tested PC board product is returned.** Wired and tested PC boards installed in the owner's cabinet or connected to switches, jacks, or cables, etc. sent to MFJ Enterprises, Inc. will be returned at the owner's expense unrepaired.

7. Under no circumstances is MFJ Enterprises, Inc. liable for consequential damages to person or property by the use of any MFJ products.

8. **Out-of-Warranty Service:** MFJ Enterprises, Inc. will repair any out-of-warranty product provided the unit is shipped prepaid. All charges will be shipped COD to the owner.

9. This warranty is given in lieu of any other warranty expressed or implied.

10. MFJ Enterprises, Inc. reserves the right to make changes or improvements in design or manufacture without incurring any obligation to install such changes upon any of the products previously manufactured.

11. All MFJ products to be serviced in-warranty or out-of-warranty should be addressed to **MFJ Enterprises, Inc., 921A Louisville Road, Starkville, Mississippi 39759, USA** and must be accompanied by a letter describing the problem in detail along with a copy of your dated proof-of-purchase.

12. This warranty gives you specific rights, and you may also have other rights which vary from state to state.